

AEROSPACE RESEARCH APPLICATIONS CENTER

Final Report

Period Ending May 31, 1969

NASA Contract NSR 15-003-054

by

Virgil E. Bradford
Manager of Technical Relations

and

Joseph DiSalvo
Director

October 15, 1969



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RESEARCH APPLICATIONS CENTER**

Aerospace Research Applications Center
Indiana University Foundation
Bloomington, Indiana

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I. INTRODUCTION

This contract was initiated in June, 1967, to evaluate the feasibility of having a document reproduction capability at a Regional Dissemination Center. The conclusion of this experimental effort is that a document reproduction capability is a valuable asset to an information center and provides the means for offering additional service to its users.

A feature of the two year period covered by this study was that there was a charge for documents ordered from ARAC after January 1, 1968, by non-member companies and after the 1968 membership renewal date for member companies. Prior to these dates, documents were available at no charge from ARAC. For this reason the number of documents ordered from the Center during the latter half of the reporting period was considerably reduced from those ordered during the earlier part. Microfiche orders did not experience the same downward trend as document orders. A record of the number of documents and microfiche ordered during the period of this report is located in Table I.

Presently an average of 500 documents per month are ordered from ARAC which have to be reproduced from microfiche or ordered from other sources. It is anticipated that this number will increase as the number of subscribers to ARAC services continues to increase.

II. EQUIPMENT

At the beginning of the study, a survey was made of the equipment available for making hard copy from microfiche. At that time it was determined that the most satisfactory type of equipment for this application was the model EL-4 Automatic Microfiche Enlarger-Printer, manufactured by the Microcard Corporation, West Salem, Wisconsin.

The factors which influenced the decision were the following: 1) cost; 2) the EL-4 used the dry process and consequently did not require water connections and the handling of chemicals; 3) the EL-4 produced one document per 8" x 11" sheet; and 4) several government information centers were contacted which were using several types of equipment under consideration preferred the EL-4. They reported that it had a higher rate of reproduction, required less maintenance, and was more reliable.

After working with the reproduction unit for some time, it was found that it did exhibit a high rate of reproduction and after the initial break-in period, its mechanical reliability was satisfactory.

However, the major problem in the system was the paper. The paper has the disadvantages of becoming dark and curling with age. The quality of the paper was a constant problem and a number of shipments had to be returned to the manufacturer for reasons of poor quality. The cost of the paper also became a negative factor in July, 1968, when there was a 45% price rise.

Several months prior to the end of this reporting period, another study was made of alternate types of equipment which could be used in this system. In June, 1969, after careful consideration of the various factors involved, the EL-4 was replaced with a Xerox microprinter. The advantages of this reproduction unit are that it uses bond paper, which is relatively inexpensive and does not deteriorate with age, and it produces one image or document page per 8" x 11" sheet. Its principle disadvantage is that it requires manual operation in moving from one page to another on the microfiche, whereas this was accomplished on the EL-4 by automated means. Under operating conditions, the volume obtained by using the Xerox reproduction unit was found to be approximately one-half of that obtained with the EL-4. However, a preliminary cost estimate showed that the cost of reproducing documents with the microprinter would be comparable to that of the EL-4.

III. DOCUMENT ORDER VOLUME

Table I presents the number of documents and microfiche ordered from ARAC during the period of July, 1967 through May, 1969. It was announced in late 1967 that there would be a charge for documents and microfiche ordered from ARAC, effective January 1, 1968. However, member companies of ARAC were not charged until their renewal date in 1968.

The fact that a large number of member companies renew in March and April explains the sharp reduction of document and microfiche orders beginning in March, 1968. The price established for documents was \$.06 per page with a \$3.00 minimum, and \$.50 per sheet for microfiche.

These prices were based in part on a cost study which was conducted during the first part of the study. Another consideration was the charge made for documents and microfiche by the Clearinghouse of the U. S. Department of Commerce. Their charge is \$3.00 per document, regardless of length, and \$.65 per document for microfiche, again regardless of the length of the document, or the number of sheets per document.

As a result many users of ARAC services order hard copy and microfiche from the Clearinghouse for reasons of cost. One aspect of this situation is that it makes it difficult for a Regional Dissemination Center to get feedback with regard to how their services are being used. For example, it is impossible to ascertain how many documents are ordered from a Standard Interest Profile by many users of these services.

However, there are several reasons why the level of document orders from ARAC has been as high as it has been since the charge was initiated. One reason is that of short turn-around time. Document orders are usually filled within a day after they are received by ARAC. The reproduction size of documents obtained from ARAC is larger than those obtained from most other sources. There is one full page image per 8" x 11" sheet produced by the EL-4 and the Xerox microprinter, while documents obtained from the Clearinghouse contain two single page images per 8" x 11" sheet.

Another reason why some users order documents from ARAC is that many companies, particularly smaller and medium-sized ones, prefer to order all of

their documents from a single source. This enables them to fill all, or at least a majority of their external information requirements, from a single source. Ordering and subsequent payment is simplified and can be easily handled through ARAC. These observations are a result of a number of company visits and interviews with users of ARAC services.

IV. COST DATA

A comparative study was made of reproduction costs before and after the policy of charging for documents was adopted. Some factor costs which changed between these periods were labor, postage, overhead, paper, and machine charges. The labor and overhead costs increased because of rising labor costs and the shorter average document length resulted in more labor being required to change microfiche and assemble documents. Shorter document length also resulted in decreased postage cost per document but increased cost per page. As cited previously, the price of paper was increased during the latter phase of the study. Since the reproduction equipment was leased at a fixed cost, the machine costs on a unit basis were greater with decreased volume.

In Figures I through VII there are listed cost data and statistics on document reproduction for the periods December 1, 1967 - February 29, 1968, and March 1, 1968 - May 31, 1969. The former period was selected because it was the last period for which statistics were available and the decreased order volume had not yet occurred because the majority of companies had not renewed their membership in 1968, which was when they had to begin paying for documents ordered from ARAC.

The latter period in the comparison is fifteen months in length, five times as long as the first period. It was chosen because the statistics and cost figures were available for the entire period and could not be readily broken down into smaller periods. One factor which biases the resulting figures for the latter period is that the cost of paper was increased by 45% in July, 1968. Since there was a considerable supply of paper on hand at the time of the price change, it was difficult to determine at what period of time this price change actually resulted in an increased price for documents. Since there was nearly an equal volume of paper at the lower and higher price during the latter period of this study, the paper cost listed in the statistics was an average of the two paper cost figures.

Figure VII shows that the average length of documents ordered from ARAC was considerably less for the latter period when there was a charge for documents as compared to the earlier period when there was no charge. The average length of documents ordered during the latter period was 40.9 pages as compared to 61.9 pages for the former. This may be explained in part by the fact that the documents of longer length are now largely being ordered from the Clearinghouse. Another factor which aids in explaining this fact is that "A" documents were made available from ARAC at the beginning of the latter period. Since the average length of these documents is shorter than those reported in STAR, NSA, or USGRDR, this resulted in a reduction of the average length of documents ordered. "A" documents presently account for approximately 20% of those ordered from ARAC.

V. COST PROJECTIONS

A projection was made of the cost of document reproduction which would be incurred with the use of the Xerox microprinter. Since several months experience of using this equipment was gained prior to preparing this report, the calculations are based on actual cost data and judgement based on operating experience.

The costs are based on the same level of document orders and length as experienced during the period immediately prior to replacing the EL-4 with the microprinter. The factors affected and the nature of change would be as follows:

1. Direct Labor - Since the microprinter requires manual operation and Overhead consequently has a slower production rate, the labor costs would be higher. Since overhead costs are a function of labor costs, they would also be higher.
2. Paper - The paper costs are much lower because bond paper is used with the microprinter.
3. Machine Costs- The cost of operating the microprinter is, in part, a function of the number of copies production. The cost of the EL-4 was based on a fixed monthly leasing cost. Under present and projected production volume, the cost of the machine per document is somewhat higher for the microprinter. However, as production volume increases the machine cost per page will decrease.

It was assumed for the purpose of this study that the document cover and postage costs would remain the same for both systems.

A summary of the projected unit copy cost for the Xerox microprinter and the historical cost data for the EL-4 are listed in Figure VIII. It can be seen that the page and document cost under present and projected production volume, and under the existing cost structure will be lower when using the Xerox microprinter. In addition, the quality of the reproduction is much superior. Both of these factors indicate that the change of reproduction equipment represented a sound decision.

VI. CONCLUSIONS

During the two year period covered by this summary report a reproduction unit was selected and document reproduction was successfully initiated and continued on a regular basis. Records of costs incurred for document preparation and mailing were maintained and a fee for reproducing documents was established. The results of this cost study are included in this report.

The equipment originally selected was replaced with another type near the end of the study. This type of reproduction unit, the Xerox microprinter, was not available at the beginning of this experiment.

The replacement was made because documents of superior quality could be produced at lower cost.

A charge was made for documents ordered from ARAC six months after the study began. This resulted in a decreased order volume, but after a period of adjustment this has remained at a relatively constant level. However, the average length of documents ordered from ARAC has decreased from sixty to forty pages. The explanations for this fact are the fee schedule which was adopted by ARAC to cover the costs of reproduction, and the fact that "A" documents were made available from ARAC after the fee schedule was adopted.

The number of documents presently ordered from ARAC averages 500 per month. Of this number approximately 300 are reproduced from microfiche by ARAC. The other documents are obtained from other sources because they are not available in microfiche form or are too expensive to reproduce due to the length of the document.

There are several principle reasons why users of ARAC services order documents from this Center. One reason is quick turn-around time. A document is usually mailed to the requestor within a day after the request is received. Another major reason is convenience. Document order forms are included with all services as they are received by the users. This provides a convenient means for the ultimate user of the services to order documents. Also, many users prefer to order all external information services and documents from one source.

The success of the document reproduction program at ARAC indicates that this capability is a valuable one for the RDC network. It provides a service with certain unique characteristics which are not available elsewhere.

TABLE I

	<u>Documents</u>	<u>Fiche</u>
July, 1967	924	114
August, 1967	1217	152
September, 1967	906	136
October, 1967	1020	115
November, 1967	1000	154
December, 1967	1132	121
January, 1968	919	131
February, 1968	1027	109
March, 1968	545	63
April, 1968	486	102
May, 1968	534	90
June, 1968	372	61
July, 1968	512	101
August, 1968	359	80
September, 1968	599	311
October, 1968	571	118
November, 1968	483	157
December, 1968	359	63
January, 1969	671	143
February, 1969	567	85
March, 1969	479	92
April, 1969	498	99
May, 1969	508	71

FIGURE I

TOTAL COPY COST ON EL-4

		<u>March 1, 1968 - May 31, 1969</u>	
		Total Dollar Outlay	Total Dollar Outlay
<u>December 1, 1967 - February 29, 1968</u>			
Direct Labor (See Figure III)	\$ 969.60	Direct Labor (See Figure III)	\$1,445.10
Paper Cost (See Figure IV)	3,592.00	Paper Cost (See Figure IV)	6,839.50
Machine Rental (See Figure V)	1,500.00	Machine Rental (See Figure V)	7,500.00
Covers for Documents (See Figure V)	43.07	Covers for Documents (See Figure V)	85.10
Overhead (See Figure III)	1,018.07	Overhead (See Figure III)	1,527.86
Postage (See Figure V)	<u>294.84</u>	Postage (See Figure V)	<u>611.52</u>
Total Cost	<u>\$7,417.58</u>	Total Cost	<u>\$18,019.08</u>

FIGURE II

UNIT COPY COST - EL-4

<u>December 1, 1967 - February 29, 1968</u>				<u>March 1, 1968 - May 31, 1969</u>			
	<u>Total Cost</u>	<u>Unit Cost* Per Page</u>	<u>Unit Cost** Per Document</u>	<u>Total Cost</u>	<u>Unit Cost* Per Page</u>	<u>Unit Cost** Per Document</u>	
Direct Labor	\$ 969.60	\$.00607	\$.37579	\$1,445.10	\$.00624	\$.25522	
Paper Cost	3,592.00	.02251	1.39359	6,839.50	.02932	1.19919	
Machine Rental	1,500.00	.00939	.58134	7,500.00	.03215	1.31493	
Postage	294.84	.00185	.11453	611.52	.00262	.10716	
Covers	43.07	.00027	.01673	85.10	.00036	.01472	
Overhead	<u>1,018.07</u>	<u>.00637</u>	<u>.39436</u>	<u>1,527.86</u>	<u>.00656</u>	<u>.26830</u>	
Total	<u>\$7,417.58</u>	<u>\$.04646</u>	<u>\$2.87634</u>	<u>\$18,019.08</u>	<u>\$.07725</u>	<u>\$3.15952</u>	

FIGURE III

LABOR COST

December 1, 1967 - February 29, 1968

	<u>Hours</u>	<u>Amount</u>	<u>Overhead</u>	<u>Total</u>
Clerical Time	24	\$ 366.90		
Service Time	<u>519</u>	<u>924.00</u>		
Total Labor Cost	<u>543</u>	<u>\$1,290.90</u>	<u>\$1,018.07</u>	<u>\$1,987.67</u>

March 1, 1968 - May 31, 1969

	<u>Hours</u>	<u>Amount</u>	<u>Overhead</u>	<u>Total</u>
Clerical Time	36	\$ 73.80		
Service Time	<u>727</u>	<u>1,381.30</u>		
Total Labor Cost	<u>763</u>	<u>\$1,445.10</u>	<u>\$1,527.86</u>	<u>\$2,982.96</u>

FIGURE IV

PAPER COST AND USAGE

<u>December 1, 1967 - February 29, 1968</u>		<u>March 1, 1968 - May 31, 1969</u>	
Footage Used	157,200	Footage Used	249,600
Paper Cost for Period	\$ 3,592.00	Paper Cost for Period	
		Paper Purchased @ \$ 8.98/Roll - 325 rolls	
		Paper Purchased @ \$13.07/Roll - 325 rolls	
		Total Paper Cost	<u>\$ 6,839.50</u>

FIGURE V

<u>December 1, 1967 - February 29, 1968</u>		<u>March 1, 1968 - May 31, 1969</u>	
<u>Machine Rental</u>			
\$500/Month	\$1,500.00	\$500/Month	\$7,500.00
<u>Covers for Documents</u>			
Price	\$1.67/100	Price	\$1.67/100
Total Documents Run	<u>2579</u>	Total Documents Run on Which Covers Were Used	<u>5,096</u>
Total Cost	<u>\$ 43.07</u>	Total Cost	<u>\$ 85.10</u>
<u>Postage</u>			
Average Page Length Per Document	61.91	Average Page Length Per Document	40.9
Average Postage Cost for 60 Page Document	<u>\$.12</u>	Average Postage Cost for 41 Pages Document	<u>\$.12</u>
Total Postage Cost - 2457 x \$.12	<u>\$ 294.84</u>	Total Postage Cost - 4096 x \$.12	<u>\$ 611.52</u>

FIGURE VI

December 1, 1967 - February 29, 1968

March 1, 1968 - May 31, 1969

Paper Wastage

Total Footage Used	157,200'	Total Footage Used	249,600'
Total Pages Run	159,600	Total Pages Run	254,456
Assuming 11" per Page	146,355	Assuming 11" per Document Page	233,252
$\frac{159,600 \times 11"}{12}$		$\frac{254,456 \times 11"}{12}$	
Footage Unaccounted for	<u>10,845'</u>	Footage Unaccounted for	<u>16,348'</u>
Percentage Unaccounted for	<u>6.89%</u>	Percentage Unaccounted for	<u>6.55%</u>

FIGURE VII

TOTAL IMPRESSIONS AND DOCUMENTS COPIED

	<u>December 1, 1967 - February 29, 1968</u>			<u>March 1, 1968 - May 31, 1969</u>		
	<u>No. of Doc's</u>	<u>Total Pages</u>	<u>Ave. Pages/Doc.</u>	<u>No. of Doc's</u>	<u>Total Pages</u>	<u>Ave. Pages/Doc</u>
IAS	110	4,461	40.06	607	18,777	20.92
Doc's	<u>2457</u>	<u>154,326</u>	<u>62.81</u>	<u>5096</u>	<u>214,475</u>	<u>42.09</u>
Total	<u>2567</u>	<u>158,787</u>	<u>61.86</u>	<u>5703</u>	<u>233,252</u>	<u>40.09</u>

FIGURE VIII

UNIT COPY COST

<u>March 1, 1968 - May 31, 1969</u>	<u>EL-4</u>	<u>Projected</u> <u>Xerox Microprinter</u>
Direct Labor	\$.00624	\$.01000
Paper Cost	.02932	.00275
Machine Rental	.03215	.04550
Toner		.00200
Postage	.00262	.00262
Covers	.00036	.00036
Overhead	<u>.00656</u>	<u>.00144</u>
	<u>\$.07725</u>	<u>\$.06467</u>